
Carrier Remote IPE product description

This chapter describes Carrier Remote Intelligent Peripheral Equipment (IPE), its architecture, and hardware options.

System overview

Meridian 1 system options 21E, 51, 51C, 61, 61C, 71, 81, and 81C as well as NT and XT systems are private branch exchange (PBX) systems that support Carrier Remote IPE service.

In addition to supporting local subscribers, each system can be configured as a distributed system that supports remote subscribers using Carrier Remote IPE modules in a column or Carrier Remote IPE cabinets. They are connected to the PBX at long distances using T1 or E1 carrier facilities.

To support the Carrier Remote IPE, the system must be running on X11 release 21 or later and must be equipped with the Carrier Remote IPE software package REM_IPE 286.

Subscriber loops at the local system site (at the PBX) are the same as at the Carrier Remote IPE modules or Carrier Remote IPE cabinets. The subscriber functions and features at the local system site are also the same as at the Remote IPE site.

This document focuses on the equipment within the PBX and the Remote IPE that is specifically designed to provide T1 or E1 carrier links between the network functions in the system and the peripheral controller functions in the Remote IPE.

System description

The Carrier Remote IPE provides PBX functionality by installing only IPE modules and IPE cards at a distant site. The Remote IPE shares the system common and network equipment to provide the same functions and features to remote subscribers that are available to local system subscribers.

To successfully implement Carrier Remote IPE functions, you must understand:

- Carrier Remote IPE physical architecture
- Carrier Remote IPE functional architecture

Carrier Remote IPE physical architecture

To configure a system with Carrier Remote IPE, you can install an IPE column or Carrier Remote IPE cabinet at a remote site and connect it, using T1 or E1 carrier links or direct copper connection (if the distance is less or equal to 200 meters or 655 feet), to an existing system. [Tables 1](#) and [2](#) list specific equipment required to support the Carrier Remote IPE at the local site and at the remote site.

Note: The cards and the cable assemblies listed in [Tables 1](#), [2](#) and [3](#) are common to T1 and E1 carrier systems, however, if E1 carrier links are terminated with BNC connectors, an external adapter cable (not supplied with the equipment) is used to connect each 8-pin modular (RJ48-type) jack on the system I/O panel assembly to the BNC connectors on each E1 carrier link.

[Table 1](#) lists all the hardware components required at the local system site to support Carrier Remote IPE service. Only one type of carrier can be supported by each Local Carrier Interface card. The carrier type is switch-selected on the Local Carrier Interface card. Appendix C provides connection diagrams and connector pin assignments for all external connectors on the I/O panel assemblies.

Table 1
Local site carrier hardware list (Part 1 of 2)

Component	Description
NT7R51 Local Carrier Interface card	Local Carrier Interface card installed in a network card slot.
NT7R66AA SDI Cable Kit	This cable kit provides a DB-9 male to DB-25 male 10-foot cable and a DB-25F/DB-25F adapter. To connect the standard SDI card to the DB-9 female P2 connector of the NT7R67DA cable at the local site, you would use the entire kit except for the DB-25F/DB-25F adapter, which is used with the SDI Paddleboard.
NT7R66BA MMI Cable	This is a DB-9 female to DB-25 male 32-foot cable. Connect the MMI terminal to the DB-9 male P3 connector of the NT7R67DA cable at the local site and directly to the MMI port of the Carrier Remote IPE site.
NT7R67BA Local Carrier/Monitor Cable Assy	This cable assembly connects the Local Carrier Interface to the network I/O panel. It consists of the NT7R67HA cable, the NT7R57AA Carrier Panel assembly, and the NT7R58AA Maintenance Panel assembly. The P1 DB-25 male connector plugs into the faceplate, the P2 DB-15HD male connector plugs into the NT7R58AA Maintenance Panel assembly, which provides two 6-pin modular system monitor jacks and one DB-9 female MMI maintenance connector. The P3 DB-15HD female connector plugs into the NT7R57AA Carrier Panel assembly, which provides three 8-pin modular carrier jacks. Refer to Appendix C, Figures 27, 28, and 31.
NT7R67CA Local Daisy-chain Cable Assy	This cable provides P1 DB-9 male connector that plugs into the faceplate and P2 DB-9 male connector that plugs into the NT7R58AA Maintenance Panel assembly. This cable is used with multiple Local Carrier Interface cards in a daisy-chain configuration or in a single Local Carrier Interface configuration to connect the MMI terminal. Refer to Appendix C, Figures 27, 28, and 31.
NT7R67DA Local External Maint. Cable Assy	Cable with the P1 DB-9 male connector that plugs into the NT7R58AA Maintenance Panel DB-9 female connector, the P3 DB-9 male connector that plugs into the MMI terminal or modem cable (or the preceding Local Carrier Interface connection in a daisy-chain), and the P2 DB-9 female connector that plugs into the SDI port (or the following Local Carrier Interface connection in the daisy-chain). Refer to Appendix C, Figures 27 and 28.
NT7R67EA Coaxial Interface Adapter Cable	Cable with one 8-pin modular plug that plugs into the NT7R57AA Carrier Panel Assy 8-pin modular jack and two BNC connectors that plug into the carrier link BNC connectors.

Table 1
Local site carrier hardware list (Part 2 of 2)

Component	Description
NT7R69AA Extension Local Carrier Cable Assy	Cable extends the NT7R67BA cable assembly. It plugs into the DB-25 connector on the Local Carrier Interface card faceplate and into the DB-25 P1 connector of the NT7R67BA cable assembly.(Used for NT and XT (QCA55/QCA58) type cabinet systems. This assembly also includes the P0846521 Connector Adapter Plate.
NT7R69BA Extension Local Maint. Cable Assy	Cable extends the NT7R67CA cable assembly. It plugs into the DB-9 connector on the Local Carrier Interface card faceplate and the P1 DB-9 connector of NT7R67CA cable assembly. Used for NT and XT (QCA55/QCA58) type cabinet systems. This assembly also includes the P0846521 Connector Adapter Plate.
NT7R87AA T1 CSU Cable Kit	This cable kit consists of a DB-15M/RJ48 adapters and a 9.75 m 32-foot RJ48 to RJ48 cable. The appropriate adapter is used to connect to a CSU and the cable is used to connect the adapter to the NT7R57AA Carrier Panel Assy RJ48 connector.
NT8D46AL System Monitor Serial Link Cable	Connects the 6-pin modular jack J5 on the NT7R58AA Maintenance Panel assembly to the system monitor jack J6 in the pedestal.
NT8D93AJ XSDI I/O to DTE or DCE Cable	This is a DB-9 male to DB-25 male 4.8 m 16-foot cable used to connect the SDI Paddleboard to the NT7R67DA Local External Maintenance Cable P2 DB-9 female connector. The entire NT7R66AA SDI Cable Kit must also be used.
NT5D40AA Hybrid kit	Used to replace BTUs in some network modules. The replacement is necessary to be able to install the Local Carrier Interface card in that slot.

Table 2 lists the hardware required for the Carrier Remote IPE UEM column at the remote site. Appendix C provides external connectors pin assignments.

Table 2
Remote Carrier IPE module hardware list (Part 1 of 2)

Component	Description
NT7R52 Remote Carrier Interface card	Remote Carrier Interface card (installed in the Remote IPE module or the Remote IPE cabinet).
NT8D37 IPE Module	Carrier Remote IPE module.
NT7R66BA MMI Cable	This is a 32-foot DB-9 female to DB-25 male cable. Connect the MMI terminal to the DB-9 male MMI connector on the NT7R61AA Maintenance Panel Assy.
NT7R68AA Remote Carrier/Alarm Cable Assy	This cable assembly connects the Remote Carrier Interface to the I/O panel at the rear of the IPE module for T1/E1 and auxiliary customer alarm connections. Consists of the NT7R68HA cable with 24-pin block P1 connector that plugs into the SL1 backplane connector, the NT7R59AA Carrier Panel assembly already connected to the cable with P2 DB-15HD male connector, and the NT7R60AA Carrier/ Alarm Panel assembly connected to the cable with P3 DB-9 female connector. The NT7R59AA Carrier Panel assembly provides two 8-pin modular carrier jacks and the NT7R60AA Carrier/Alarm Panel assembly provides one 8-pin modular carrier jack and one DB-15 female alarm connector. Refer to Appendix C, Figure 29.
NT7R68BA Remote Maintenance Cable Assy	This cable assembly connects the Remote Carrier Interface to the I/O panel at the rear of the IPE module for system monitor and MMI connections. Consists of the NT7R68GA cable with 24-pin block P1 connector that plugs into the SL1 connector on the backplane, the NT7R61AA Maintenance Panel assembly already connected to the cable with P2 DB-15 male cable connector. The NT7R61AA Maintenance Panel assembly provides one 6-pin modular jack for system monitor and one DB-9 male MMI port connector. Refer to Appendix C, Figure 29.
NT7R67EA Coaxial Interface Adapter Cable	Cable with one 8-pin modular plug that plugs into the NT7R68AA Remote Carrier/Alarm Panel Assy 8-pin modular jack and two BNC connectors that plug into the carrier link BNC connectors.

Table 2
Remote Carrier IPE module hardware list (Part 2 of 2)

Component	Description
NT7R86AA Auxiliary Alarm Cable Assy	Connects auxiliary alarms, such as customer external alarms, to the DB-15HD female Alarm connector on the NT7R60AA Carrier/Alarm Panel. The cable is 9.75 m 32 feet long.
NT7R87AA T1 CSU Cable Kit	This cable kit consists of a DB-15M/RJ48 adapters and a 9.75 m 32-foot RJ48 to RJ48 cable. The appropriate adapter is used to connect to a CSU and the cable is used to connect the adapter to the NT7R59AA Carrier Panel Assy and the NT7R60AA Carrier/Alarm Panel Assy RJ48 connector.
NT8D46AL System Monitor Serial Link Cable	Connects the 6-pin modular jack J5 on the NT7R61AA Maintenance Panel assembly to the J6 system monitor jack in the pedestal.

[Table 3](#) lists the Carrier Remote IPE cabinet equipment. Appendix C provides external connectors pin assignments.

Table 3
Carrier Remote IPE wall-mounted cabinet hardware list (Part 1 of 3)

Component	Description
NT7R52 Remote Carrier Interface card	Remote Carrier Interface card (installed in the Remote IPE module or the Remote IPE cabinet).
NTIP70 Main Cabinet Assy	Main wall-mounted (or pedestal mounted) Carrier Remote IPE cabinet. The NT1P70 consists of the NT1P60 Main Cabinet and mounting hardware.
NTBK70 Expansion Cabinet	Expansion Carrier Remote IPE cabinet. Expands the capacity by six IPE cards. Requires the NTAK1204 Inter-Cabinet cable to connect to the main cabinet.
NTAK27 Pedestal for the Cabinet (optional)	This pedestal allows the Carrier Remote IPE cabinets to be floor-mounted.
NT7R66BA MMI Cable	This is a 9.75 m 32-foot DB-9 female to DB-25 male cable. Connect the MMI terminal to the DB-9 male MMI connector on the NT7R61AA Maintenance Panel Assy.
NT7R67EA Coaxial Interface Adapter Cable	Cable with one 8-pin modular plug that plugs into the NT7R68CA Remote Carrier/Alarm Panel Assy 8-pin modular jack and two BNC connectors that plug into the carrier link BNC connectors.

Table 3
Carrier Remote IPE wall-mounted cabinet hardware list (Part 2 of 3)

Component	Description
NT7D68DA Remote Maintenance Cable Assy to Cabinet	This cable assembly connects the Remote Carrier Interface to the I/O bracket on the wall-mount IPE cabinet for system monitor and MMI connections. Consists of the NT7R68NA cable that connects with P1 DB-9 male connector to the TTY connector on the backplane and is already connected to the NT7R61AA Maintenance Panel assembly with the DB-15 male P2 cable connector. The DB-15 female P3 cable connector must be plugged into the NT7R60AA Carrier/Alarm Panel assembly connector during cable installation. The NT7R61AA Maintenance Panel assembly provides a DB-9 male MMI port connector. Refer to Appendix C, Figure 30.
NT7R86AA Auxiliary Alarm Cable Assy	Connects auxiliary alarms, such as customer external alarms, to the DB-15HD female Alarm connector on the NT7R60AA Carrier/Alarm Panel. The cable is 9.75 m 32 feet long.
NT7R87AA T1 CSU Cable Kit	This cable kit consists of a DB-15M/RJ48 adapters and a 9.75 m 32-foot RJ48 to RJ48 cable. The appropriate adapter is used to connect to a CSU and the cable is used to connect the adapter to the NT7R59AA Carrier Panel Assy and the NT7R60AA Carrier/Alarm Panel Assy RJ48 connector.
NT7R94AA Remote Cabinet Cable Assy	This Remote Cabinet Cable Assembly consists of the NT7R68CA Remote Carrier/Alarm Cable Assy, the NT7R68DA Remote Maintenance Cable Assy, and the NT7R62AA Bracket. All components are preinstalled in the factory.
NT7D68CA Remote Carrier/Alarm Cable Assy to Cabinet	This cable assembly connects the Remote Carrier Interface to the I/O bracket of the wall-mount IPE cabinet for T1/E1 and auxiliary customer alarm connections. It consists of the NT7R68LA cable that connects with DB-15 male P1 to the Auxiliary Connector on the backplane, the NT7R59AA Carrier Panel assembly that connects to P2 DB-15 female cable connector, and the NT7R60AA Carrier/Alarm Panel assembly that connects to P3 DB-9 female cable connector. The NT7R59AA Carrier Panel (installed in slot 1 of the bracket) provides two 8-pin modular carrier jacks and the NT7R60AA Carrier/Alarm Panel (installed in slot 2 of the bracket) provides one 8-pin modular jack and one DB-15 female alarm connector. The two panels are already connected to the NT7R68LA cable. Refer to Appendix C, Figure 30.
NT7D68DA Remote Maintenance Cable Assy to Cabinet	This cable assembly connects the Remote Carrier Interface to the I/O bracket on the wall-mount IPE cabinet for system monitor and MMI connections. Consists of the NT7R68NA cable that connects with P1 DB-9 male connector to the TTY connector on the backplane and is already connected to the NT7R61AA Maintenance Panel assembly with the DB-15 male P2 cable connector. The DB-15 female P3 cable connector must be plugged into the NT7R60AA Carrier/Alarm Panel assembly connector during cable installation. The NT7R61AA Maintenance Panel assembly provides a DB-9 male MMI port connector. Refer to Appendix C, Figure 30.

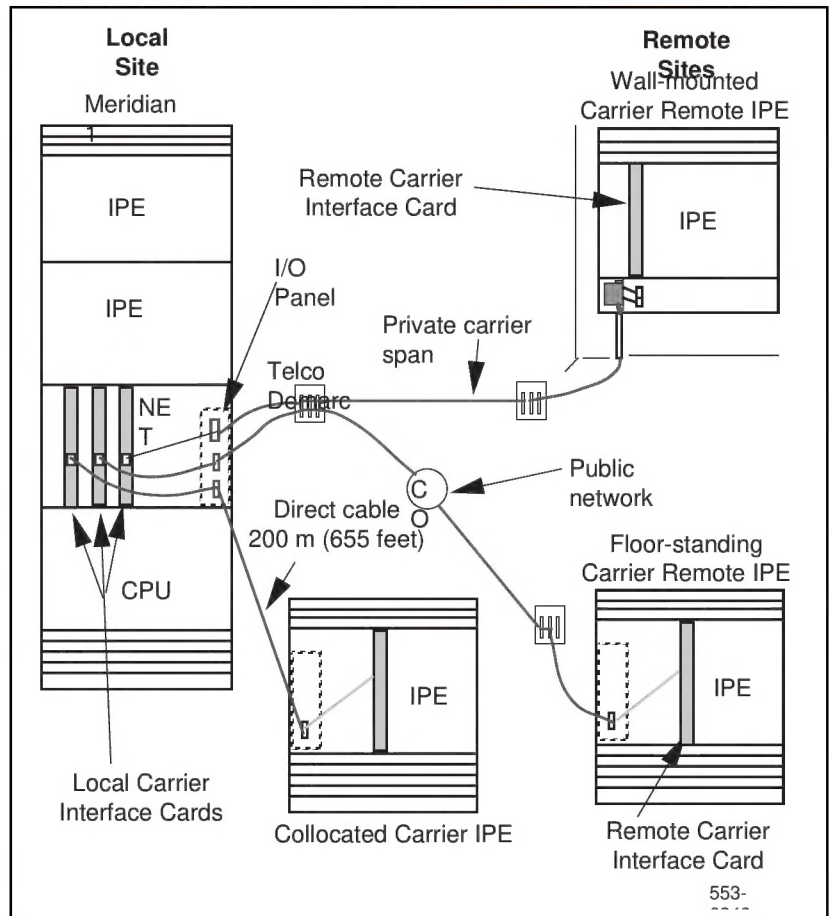
Table 3

Carrier Remote IPE wall-mounted cabinet hardware list (Part 3 of 3)

Component	Description
NTAK04 AC/DC Power Supply for Cabinet	Used when the Carrier Remote IPE cabinet is AC-powered by the commercial power source or UPS.
NTAK05 DC Power Supply for Cabinet	Used when the Carrier Remote IPE cabinet is DC-powered by a - 52VDC power source.
NTAK410 Power Cable for DC Power Supply	Used to connect the cabinet to a reserve battery power supply or to a DC power source through the NTAK28 Junction Box.
NTAK1204 Inter-cabinet Cable	Used to connect the main to the expansion Carrier Remote IPE cabinet.

Figure 1 illustrates Meridian 1 and Remote IPE equipment linked with T1 or E1 carriers over the private network, the public network, and for distances of 655 feet (200 m) or less direct copper cable connection to a collocated Carrier IPE column. The T1 and normally E1 carrier links use 120-ohm twisted pair wires. However, if the E1 carrier links use coaxial cable, 75-ohm impedance must be selected using SW1, SW2, SW5, and SW8 on the Local and Remote Carrier Interface cards (refer to **Figure 9** and **Figure 15**).

Figure 1
Meridian 1 to Remote IPE links



The only equipment specifically designed to support this configuration are the types of cards, cables, and cabinets listed previously in [Tables 1](#) and [2](#). All the other equipment is standard Meridian 1 hardware.

At the local site, there are two cables that plug into the Local Carrier Interface card faceplate connectors. At the other end, the cable connectors connect to the I/O panel connectors at the rear of the Meridian 1 network module. At the remote site, two cables that plug into the backplane connectors behind the Remote Carrier Interface card contain connectors that are also plugged into the I/O panel connectors at the rear of the Carrier Remote IPE module.

All systems use the same carrier hardware. The cable routing and the location of the I/O panel assemblies is different.

For the Carrier Remote IPE cabinet, two cables connect P2 and P3 backplane connectors to the I/O panel connectors installed on a bracket at the lower left-hand side of the cabinet backplane as shown in [Figure 3](#).

Subscriber loops at the Remote IPE are connected to 50-pin connectors on the I/O panel at the rear of the module or at the bottom front of the cabinet as in standard hardware. For more details about subscriber connections to Meridian 1 and the Remote IPE, refer to *Meridian 1 system installation procedures* (553-3001-210).

You can select one of two options for the Remote IPE enclosure:

- Carrier Remote IPE column
- Carrier Remote IPE cabinet

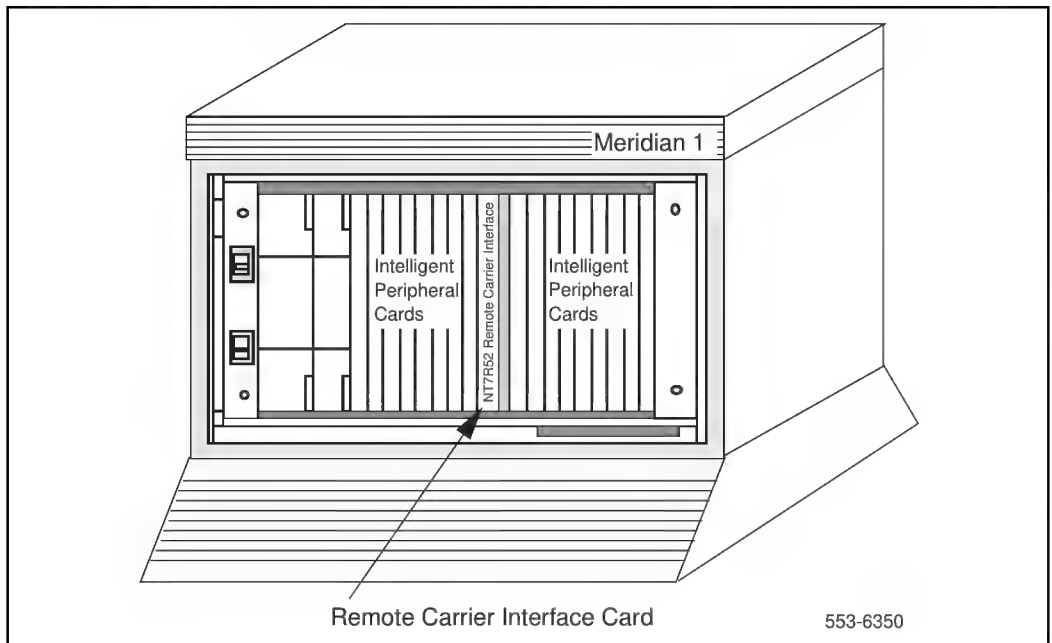
Carrier Remote IPE column

Floor-standing Carrier Remote IPE column includes a pedestal, one or more standard NT8D37 IPE Modules, and a top cap. The IPE module houses a maximum of 16 line cards and a Remote Carrier Interface card. Each Remote Carrier Interface card supports IPE cards in only one IPE module. Therefore, each IPE module requires a Remote Carrier Interface card and one to three T1 or E1 carrier links.

The T1 or E1 carrier link is connected to the Remote Carrier Interface card through the carrier connectors located on the I/O panel at the rear of the IPE module. A cable connects the Remote Carrier Interface card through the backplane to the I/O panel at the rear of the IPE module to establish a connection to the carrier link.

Figure 2 illustrates the front view of the Carrier Remote IPE column with the Remote Carrier Interface card and the IPE cards already installed.

Figure 2
Carrier Remote IPE column



Carrier Remote IPE cabinet

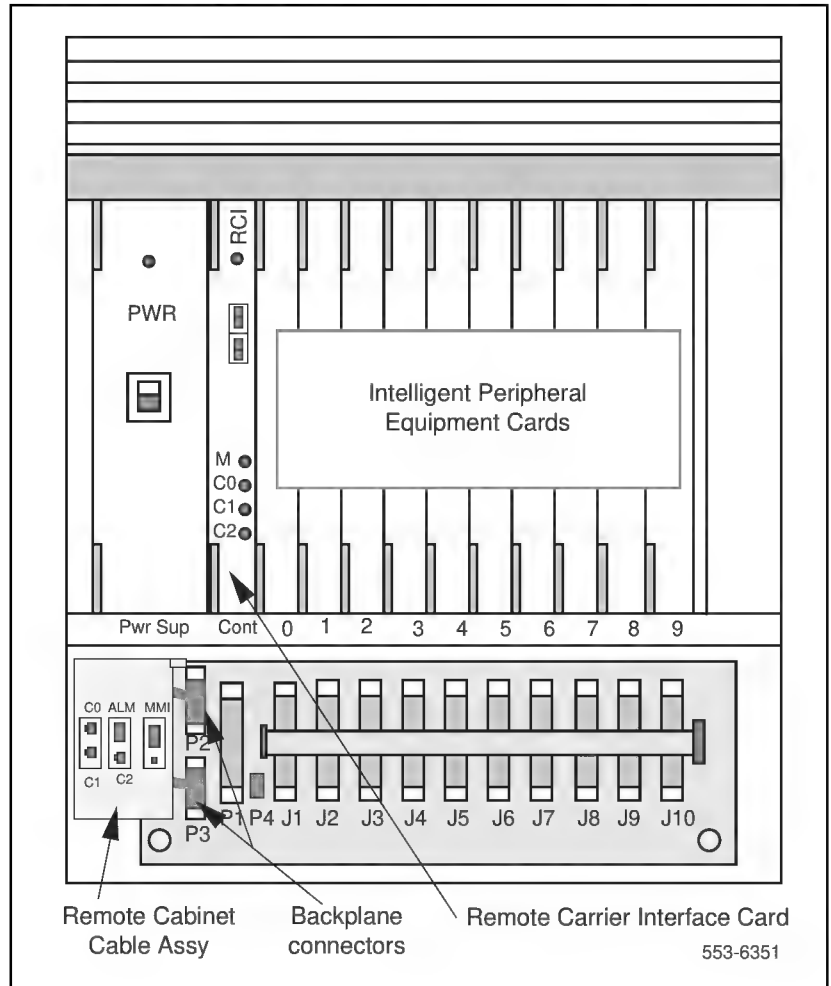
Each Remote Carrier Interface card supports up to 16 IPE cards. The NT1P70/NT1P60 main Carrier Remote IPE cabinet houses an NT7R52 Remote Carrier Interface card and up to 10 IPE cards. This cabinet is the same as used in the Fiber Remote Carrier IPE application. The cabinet is then modified for the Carrier Remote IPE application by simply replacing the existing I/O bracket with NT7R94AA Remote Cabinet Cable Assembly. If additional IPE cards are required, you must use the NTBK70 expansion cabinet, which can house up to six additional cards in card slots 10 through 15. Card slots 16 through 19 in the expansion cabinet are not configurable and must not be used. The main and the expansion cabinets are interconnected by a cable that plugs into the P1 connector located in the lower left-hand corner of each cabinet's backplane.

The T1 or E1 carrier link is connected to the Remote Carrier Interface card through P2 and P3 backplane connectors. These backplane connectors are connected to the I/O panel, which is mounted on a bracket at the lower left-hand corner of the cabinet backplane.

Carrier Remote IPE main and expansion cabinets can be AC or DC powered. The power source is directly connected to the shelf power supply for the AC-powered system and to the shelf power converter for the DC-powered system.

Figure 3 illustrates the front view of the NT1P70/NT1P60 Carrier Remote IPE cabinet. It also shows the location of the NT7R52 Remote Carrier Interface card.

Figure 3
Carrier Remote IPE cabinet



Carrier Remote IPE functional architecture

Carrier Remote IPE functions are controlled by the system CPU and the firmware in the Local Carrier Interface and Remote Carrier Interface cards. The CPU uses software instructions to execute call processing, administration, and diagnostic functions. These functions can be divided into three basic categories:

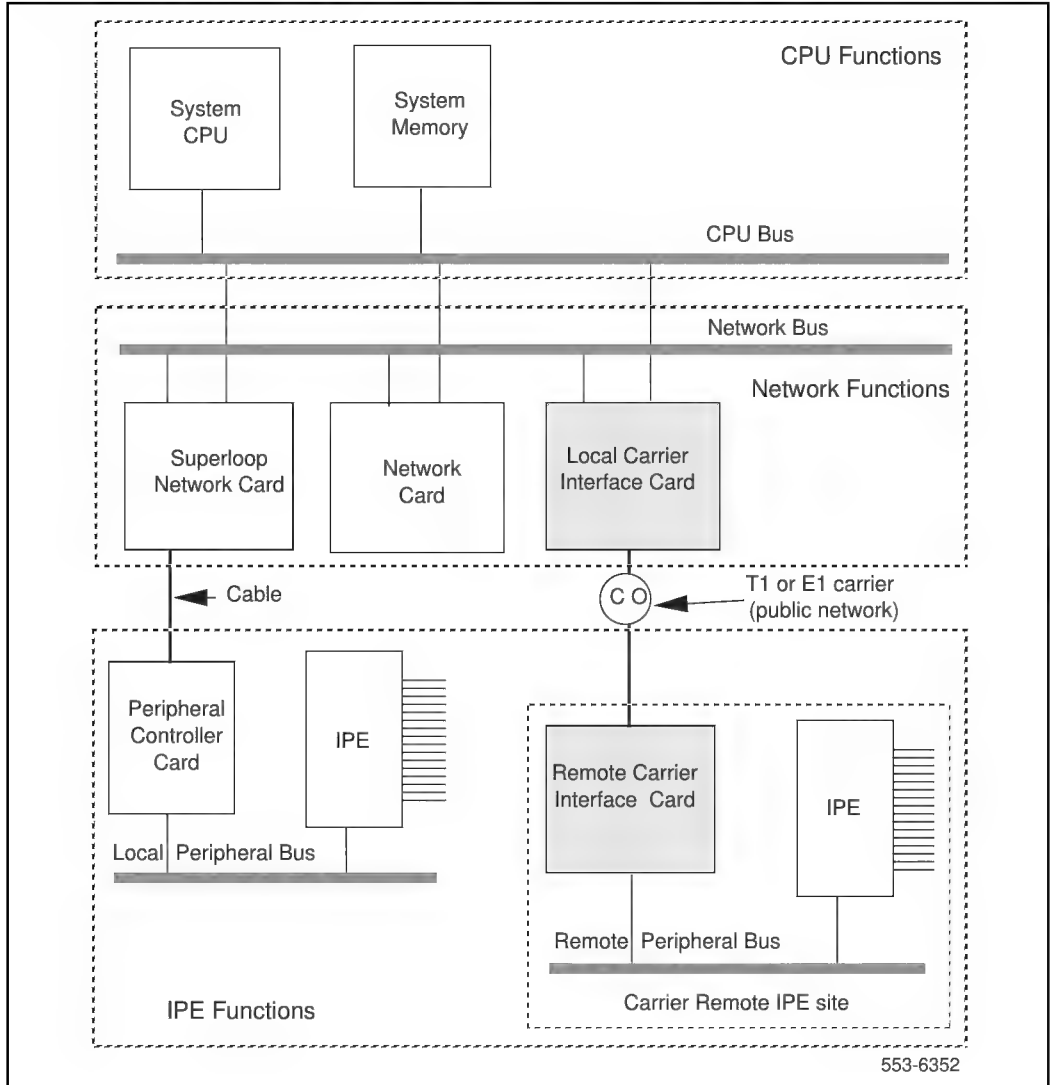
- CPU functions
- Network functions
- IPE functions

The communication and signaling between the system and the Carrier Remote IPE is performed over the first three timeslots of each T1 or E1 carrier link including the spare link. The other timeslots of each carrier link are used to transmit voice and data information originating and terminating at Remote IPE subscriber stations. All three carriers transmit the same messages and signaling across the carrier link; however, the system selects only one carrier for signaling and message handling. Which carrier it uses depends on the past carrier link events, or when one carrier has a lower error rate than the other carriers in the link, the system selects the carrier with the lowest error rate for signaling and message extraction.

A T1 or an E1 carrier link between the Local Carrier Interface card and a Remote Carrier Interface card can be configured with one to three carrier links, where all three links carry traffic or where one of the two links can be assigned as a spare link that is standing by to take over traffic when an active link fails.

Figure 4 illustrates the system functional architecture on a broad block diagram level to show the three basic types of functions.

Figure 4
System functional architecture



To maintain optimum service during carrier failure and recovery, the system automatically enables the exact number of timeslots required for the number of active physical links between the system and the Carrier Remote IPE. All the other timeslots provided by the superloop are inhibited to prevent system assignment of too many timeslots for the number of active carriers in the link. If the number of active links changes due to failure of one or more links, or if reactivation of a previously faulty link occurs, the system dynamically adjusts the number of available timeslots to support currently active carriers in the link.

CPU functions

CPU functions are executed by the system software in the CPU module or shelf. The CPU responds to the interrupt requests from the network equipment and the IPE, and performs the following functions:

- controls originating calls, terminating calls, and feature operation for switched voice and data calls
- prevents establishing new data calls if CALS= 2
- executes system administration and configuration functions
- coordinates system diagnostic activities
- controls system utility functions such as software loading, initialization, data dumping, traffic logging, and system auditing

Even though the Remote IPE is removed from the system, the system CPU controls its functions the same way it controls functions of telephones and stations connected to line cards in local IPE modules.

Network functions

Network switching functions are executed by the equipment housed in the system network card slots. The Local Carrier Interface card is installed in a network card slot and, through its T1 or E1 carrier links, connects to the Remote Carrier Interface card installed in the Carrier Remote IPE module or cabinet.

The system provides these network functions:

- performs hardware initialization and self-test upon power up
- establishes call connections between stations connected to Remote IPE line cards and stations local to the system or to trunks for long distance trunk calls over public or private networks
- communicates switching, peripheral signaling, and maintenance information to and from the CPU, the Local Carrier Interface card MPU, and the Remote Carrier Interface MPU
- manages timeslot assignment for active carrier links and timeslot blocking of the remaining timeslots on the superloop that are not required to support the existing active carrier links
- monitors T1 or E1 carrier link integrity and transmission quality and provides automatic link switching from the failed primary link to the spare link, if so configured
- optionally, if PRI/DTI/BRI cards are not installed in the system, provides clock to the Clock Controller card to synchronize the network bus to the T1 or E1 carrier clock
- provides local and remote loopback testing and fault isolation functions

IPE functions

Intelligent peripheral equipment functions are performed by the Remote Carrier Interface card and line cards in the Carrier Remote IPE module or Carrier Remote IPE cabinet.

The system provides these IPE functions:

- performs hardware initialization and self-test upon Remote Carrier Interface card power-up
- assigns timeslots to line cards to establish call connections
- communicates with the Local Carrier Interface card MPU to provide Remote IPE configuration and maintenance functions
- monitors the link integrity and transmission quality and notifies the Local Carrier Interface card, which provides automatic carrier switching from the failed primary carrier to the spare carrier 2 if the link is set up with the spare carrier option
- provides Card-LAN management by polling IPE cards and reporting their status
- controls local station ringing functions
- provides a serial port for local configuration and maintenance functions
- provides local and remote loopback testing and fault isolation functions

Functional description

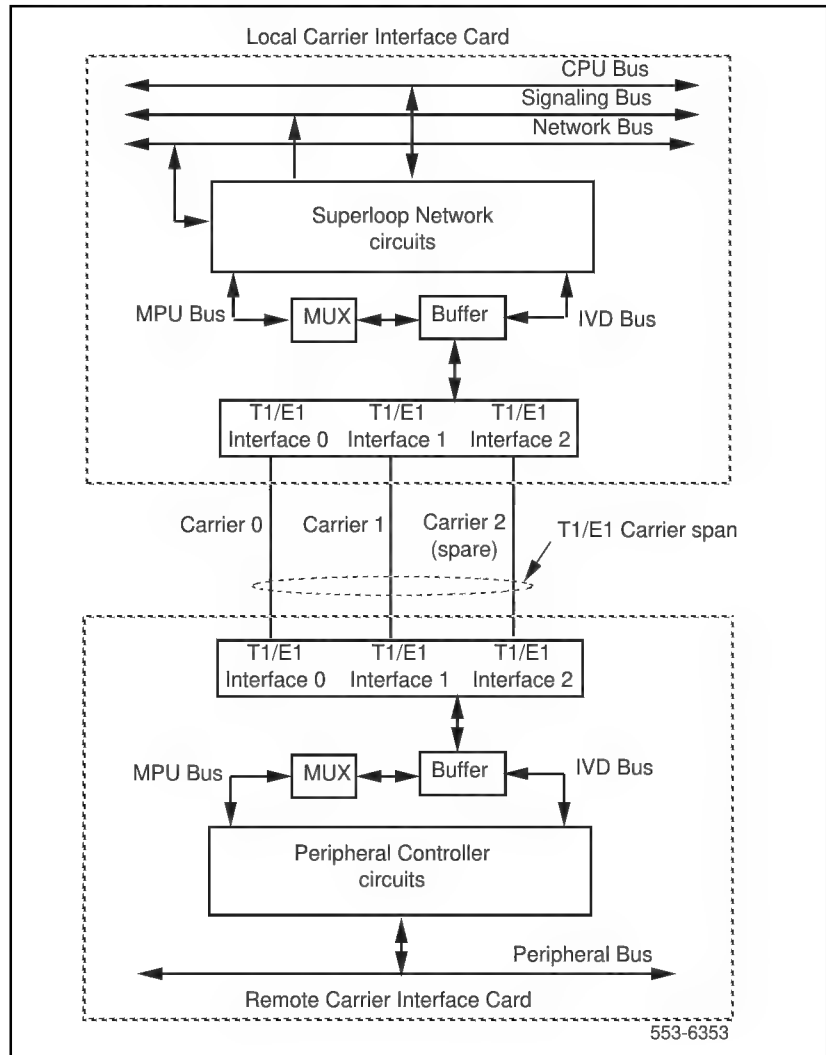
The system is controlled by the CPU. The CPU performs read/write functions on the network control and status registers and communicates with the network equipment over the CPU bus. Through these messages, the CPU monitors the system status, provides call connection sequences, monitors traffic activities, downloads application software and configuration data, and performs system administration and diagnostics.

Carrier Remote IPE utilizes T1 or E1 carrier links to provide the same subscriber functionality at the remote site as at the Meridian 1 local site.

[Figure 5](#) illustrates the Carrier Remote architecture. It shows the Local Carrier Interface card, the Remote Carrier Interface card, and the internal bus structure that connects them to other system components.

Figure 5 shows the carrier interface circuits to provide an understanding of the internal system communication and call processing activities through the T1 or E1 carrier link.

Figure 5
Meridian 1 Carrier Remote architecture



Local Carrier Interface card

The Local Carrier Interface card is a microprocessor-controlled network interface between the system CPU and the remote peripheral equipment. To communicate with the CPU, the system uses the network, the signaling, and the CPU buses located in the system network module.

The Local Carrier Interface card occupies one network card slot and supports a maximum of 120 timeslots for voice and data transmission with the Remote Carrier Interface card.

A subset of these available timeslots are dynamically activated depending on T1 or E1 carrier and the number of active links in the carrier link. A maximum of 63 timeslots are used for a T1 link with three active carriers or a maximum of 81 timeslots are used for an E1 link with three active carriers. Timeslots that are not associated with physical T1 or E1 carriers are disabled. This prevents assigning carrier-inaccessible timeslots to the peripheral equipment.

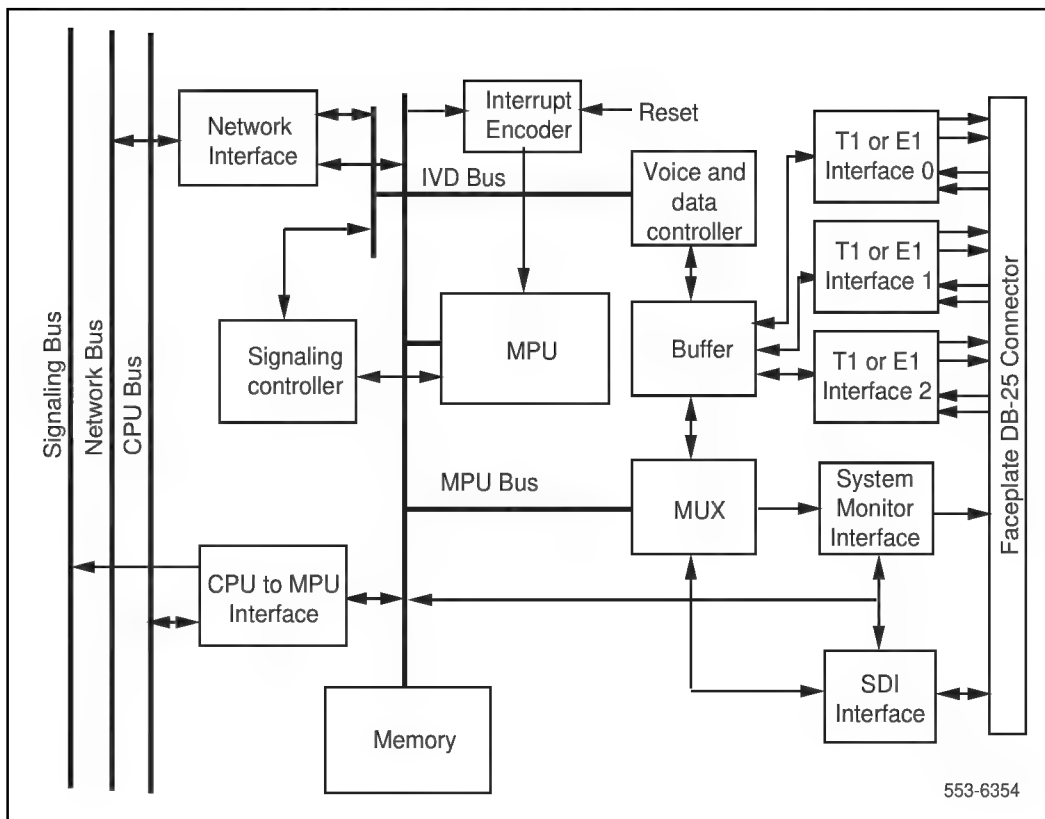
The main Local Carrier Interface card provides the following functions:

- provides from one to three dedicated T1 or E1 carrier links to connect the Carrier Remote IPE to the system
- assigns specific network timeslots to each T1 or E1 carrier link to communicate with the peripheral equipment
- synchronizes the system Clock Controller with the clock signal recover from the carrier link
- manages the carrier administration, maintenance, performance monitoring, and automatic carrier reconfiguration
- provides a miscellaneous timeslot (timeslot 2) in each T1 or E1 link to support multiplexed Card-LAN, SDI transport, system monitor, and carrier maintenance information
- supports two signaling timeslots (timeslots 0 and 1) in each carrier link to transmit signaling information across the link
- provides elastic store (two frames long) to compensate for delays between different carriers in the link and allow for proper alignment of all the timeslots on the internal voice/data (IVD) bus

- provides an interface for system power and alarm monitoring
- provides an interface for a maintenance port
- provides continuity test pattern generation and detection for loopback testing
- performs diagnostic self-tests during power-up and also when requested by the CPU

Figure 6 shows the Local Carrier Interface card block diagram illustrating major functional blocks.

Figure 6
Local Carrier Interface card functional block diagram



Micro Processing Unit (MPU)

The MPU coordinates and controls data transfer and addressing of the peripheral devices and communicates with the system CPU using a message channel on the CPU bus. The tasks that the MPU performs depend on the interrupts it receives. These interrupts are prioritized by the importance of the tasks they control.

The MPU is highly integrated and provides most of the decision making logic on the chip. Functions of the MPU include controllers, timers, control and arbitration logic, address decoding, dual-port RAM and independent direct memory access, input/output ports, and independent full-duplex serial communication channels that support various protocols.

The MPU can be reset by:

- powering up the Local Carrier Interface card
- the watchdog timer
- the ENB/DIS switch
- the system CPU command

Memory

The Local Carrier Interface memory stores the following programs and data:

- Boot code, self-test code, and operating firmware are stored in the EPROM.
- Data is stored in the RAM.
- Code that is downloaded by the Meridian 1 CPU to the Local Carrier Interface card MPU and main function code are stored in the RAM.
- Data containing the Local Carrier Interface card identification and version is stored in the EEPROM.

CPU to MPU bus interface

Information exchange between the system CPU and the Local Carrier Interface MPU is performed with packetized messages transmitted over the CPU bus.

This interface uses shared static random access memory (SRAM) as a communication exchange point between the CPU and the MPU. Both the CPU and the MPU can access this memory over the transmit and receive channels on the CPU bus.

Network bus interface

The network bus interface performs two major functions:

- converts bit interleaved serial data received from the network bus into byte interleaved data for transmission over the timeslots used by the IVD bus
- accepts byte interleaved data transmitted from the IVD bus and converts it into a bit interleaved data stream for transmission over the network bus

Carrier interface

Each Local Carrier Interface card has three T1/E1 interfaces to provide two primary links and a spare, or three primary T1 or E1 carrier links. Each T1 or E1 carrier interface is switch-selectable to a 1.5 Mbps T1 or a 2 Mbps E1 point-to-point transmission facility. A carrier interface card does not support a combination of T1 and E1 carrier links on a carrier link; it supports only T1 or E1 carriers.

The T1 or E1 carrier interface performs the following functions:

- Connects the system to Remote IPE using one to three T1 or E1 carrier links.
- Provides a communication channel between the Local Carrier Interface card MPU and the Remote Carrier Interface card MPU over timeslot 2 of each carrier. It also multiplexes the system monitor, Card-LAN, and the SDI port information and transmits it over timeslot 2 across the link.

- Transmits signaling information across the carrier link by using timeslots 0 and 1 of each carrier.
- Provides a distance-selectable switch that selects the distance from the Local Carrier Interface card to the first signal regenerator such as a repeater, a CSU, or an LTU in the carrier link to be from 0 to 200 m (0 to 655 ft).
- Uses elastic store buffers to store two frames of carrier data stream to compensate for possible information propagation delays between different carrier timeslots in the link. This allows for proper timeslot alignment of all the carriers on the IVD bus.
- Identifies the card and firmware versions, which are stored in the EEPROM.
- Monitors transmission quality of the link. If the transmission is degraded or fails, the Local Carrier Interface card automatically transfers to the spare link, if equipped.

Remote Carrier Interface card

The Remote Carrier Interface card is a microprocessor-controlled peripheral interface between the Local Carrier Interface card and the Remote IPE line cards. To communicate with the Local Carrier Interface card, the Remote Carrier Interface card uses one to three T1 or E1 carrier links. To communicate with the peripheral equipment, the Remote Carrier Interface uses 16 full-duplex serial loops, one for each line card in the Carrier Remote IPE module or Carrier Remote IPE cabinets.

The Remote Carrier Interface card occupies one controller card slot in the IPE module. However, the adjacent card slot is not the full width and must remain empty. This narrower card slot is due to the fact that a standard peripheral controller card occupies two card slots in the IPE module, and the Remote Carrier Interface card that plugs into the same backplane connector, occupies only one card slot. The dummy faceplate can be used in the empty card slot in the Carrier Remote IPE module for aesthetic reasons but is not needed in the Carrier Remote IPE cabinet.

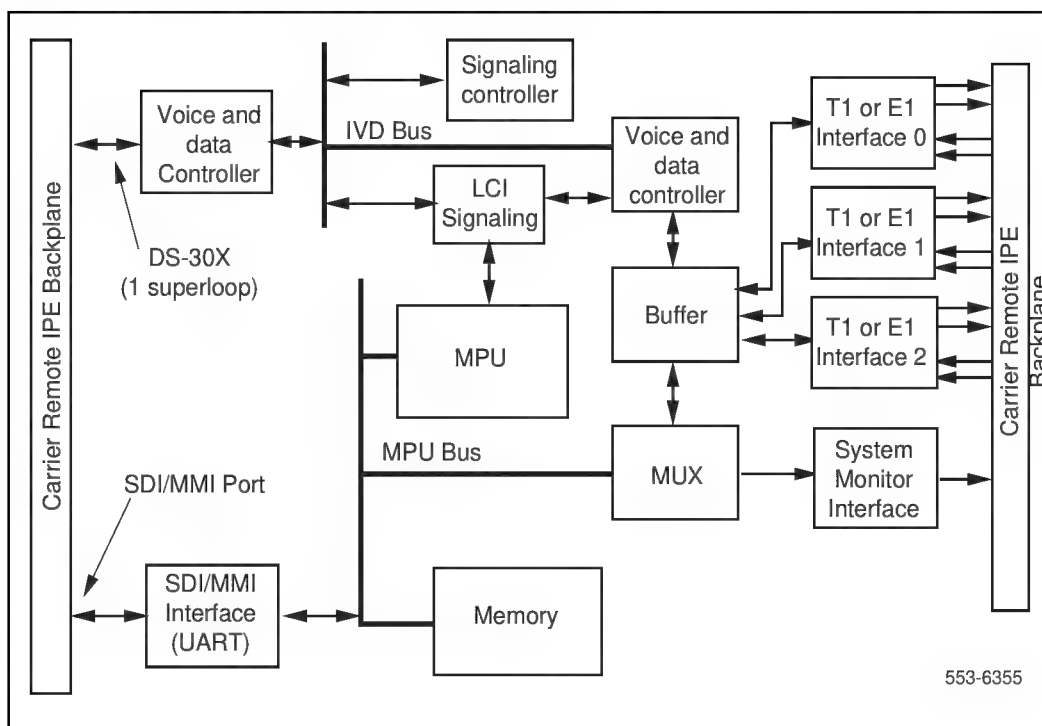
The main Remote Carrier Interface card provides the following functions:

- Provides one to three T1 or E1 carrier links to connect the Carrier Remote IPE to the system.
- Assigns timeslots on the T1 or E1 carrier link to timeslots of the 16 full-duplex serial loops assigned to line cards in the IPE module.
- Provides a Remote Carrier Interface Microprocessor (RCIM) to execute administrative and MMI port commands and manage the carrier administration, maintenance, performance monitoring, and automatic carrier reconfiguration.
- Transmits signaling information across the carrier link by using timeslots 0 and 1 of each carrier.
- Provides a communication channel between the Local Carrier Interface card MPU and the Remote Carrier Interface card MPU over timeslot 2 of each carrier. It also multiplexes the system monitor, Card-LAN, and the MMI port information and transmits it over timeslot 2 across the carrier link.
- Uses elastic store buffers to store two frames of carrier data stream to compensate for possible information propagation delays between different carriers in the link. This allows for proper timeslot alignment of all carriers on the IVD bus.
- Provides a distance-selectable DIP switch that selects the distance from the Remote Carrier Interface card to the first signal regenerator such as a repeater, a CSU, or an LTU in the carrier link to be from 0 to 200 m (0 to 655 ft).
- Converts SSD-type signaling format received from the Local Carrier Interface card to the signaling format for digital telephone sets, and from the digital telephone sets format to SSD-type format.
- Polls telephone sets to determine the line type and its signaling protocol and transmits this information to the Local Carrier Interface card.
- Provides an interface for MMI administration and maintenance ports.

- Provides continuity test, line card polling, card enabling/disabling, and loopback testing functions.
- Accesses up to three external alarm inputs, which are multiplexed with maintenance and diagnostic messages sent to the Local Carrier Interface card MPU.
- Provides an interface for system power and alarm monitoring.
- Performs diagnostic self-tests during power-up and when requested by the CPU.

Figure 7 shows the Remote Carrier Interface card block diagram illustrating major functional blocks. Functions of these blocks are described in the following sections.

Figure 7
Remote Carrier Interface card functional block diagram



Micro Processing Unit (MPU)

The MPU coordinates and controls data transfer and addressing of the peripheral devices and communicates with the Local Carrier Interface card using serial communication channels over the carrier timeslot 2. Tasks that the MPU performs depend on the interrupts it receives. These interrupts are prioritized by the importance of the tasks they control.

The MPU is highly integrated and provides most of the decision making logic on the chip. Functions of the MPU include controllers, timers, control logic, address decoding, dual-port RAM and independent direct memory access, parallel input/output ports, and independent full-duplex serial communication channels that support various protocols.

The MPU can be reset by:

- powering up the Remote Carrier Interface card
- the watchdog timer

Memory

The Remote Carrier Interface memory stores the following programs and data:

- Boot code and self-test code are stored in the EPROM.
- Data is stored in the RAM.
- Code that is downloaded by the system CPU to the Remote Carrier Interface card and main MPU function code are stored in the RAM.
- Data containing the Remote Carrier Interface card identification and version is stored in the EEPROM.

Card-LAN interface

To implement the Card-LAN interface, the Remote Carrier Interface card uses a dual-UART device. One UART channel is a serial communication interface to IPE cards and the other channel is the communication link between the Local Carrier Interface card and the Remote Interface card MPUs over the carrier link. Card-LAN function is performed in the system and it doesn't provide an external physical connection.

The Card-LAN is a 19.2 kbps asynchronous interface. It is used to poll and communicate with IPE cards through the Remote Carrier Interface card to transmit maintenance messages, which include:

- LED control of the IPE card enable/disable
- Peripheral card configuration
- Peripheral card type and version information

IPE interface

The IPE interface links IPE cards to the Remote Carrier Interface MPU using sixteen DS-30X loops, one for each IPE card, and contains the following Remote Carrier Interface circuits:

- Dual formatter that transforms serial peripheral loop information into parallel Integrated Voice and Data (IVD) bus information and parallel IVD bus information to serial peripheral loop information.
- Message handler that performs channel associated signaling to and from the IPE cards. It receives signaling information from the IPE cards; then the MPU accesses this information, interprets it, and sends it to the Local Carrier Interface in the appropriate format. From the Local Carrier Interface, the signaling messages are received and interpreted by the Remote Carrier Interface MPU and sent to the serial peripheral loops in the appropriate format.
- Timeslot interchange that provides the correspondence between the voice and data timeslots on the T1 or E1 carrier link and the timeslots on the IVD bus. Timeslots on the IVD bus correspond directly to the peripheral line card loops.
- Signaling timeslots on each carrier link that handle the signaling to and from the Local Carrier Interface card. It receives signaling information from the Local Carrier Interface card and transmits it to the Remote Carrier Interface card MPU for processing. It also processes the signaling information in the opposite direction by receiving the signaling information from the Remote Carrier Interface card MPU and transmitting it to the Local Carrier Interface card MPU over the T1 or E1 carrier links.

Carrier interface

Each Remote Carrier Interface card provides three T1 or E1 carrier interfaces. The Remote Carrier Interface card can have three primary links or two primary links and one spare. It provides a switch-selectable 1.5 Mbps T1 or a 2.0 Mbps E1 point-to-point transmission facility.

The T1 or E1 carrier interface performs the following functions:

- Connects the system to Remote IPE using one to three T1 or E1 carrier links.
- Provides a distance-selectable switch that selects the distance from the Remote Carrier Interface card to the first signal regenerator such as a repeater, a CSU, or an LTU in the carrier link to be from 0 to 200 m (0 to 655 ft).
- Transmits signaling information across the link by using timeslots 0 and 1 of each carrier.
- T1 line signal coding across the carrier link is B8ZS.
- Extended Superframe (ESF) is preferred (instead of D4) for T1 links because it provides CRC6 error monitoring, which provides end-to-end performance checking.
- E1 line signal coding across the carrier link is HDB3.
- Meridian 1 system is used as the clock source to synchronize the communication between the local and remote sites over carrier links.
- Provides a communication channel between the Local Carrier Interface card MPU and the Remote Carrier Interface card MPU over timeslot 2 of each carrier link. It also multiplexes the system monitor and the SDI port information and transmits it over this carrier timeslot across the link.
- Uses elastic store buffers to store two frames of carrier data stream to compensate for possible information propagation delays between different carriers in the link. This allows for proper timeslot alignment of all the carrier links on the IVD bus.
- Identifies card and firmware versions, which are stored in the EEPROM.
- Monitors transmission quality of T1 or E1 carrier links. If the transmission is degraded or fails, the Remote Carrier Interface card automatically transfers to the spare link, if equipped.

Engineering guidelines

Meridian 1 general system engineering guidelines are described in *Meridian 1 system engineering* (553-3001-151). The following information deals specifically with engineering guidelines for the Carrier Remote IPE planning and implementation.

Carrier Remote IPE capacity

Meridian 1 physical capacity depends on the system configuration and size. System options 21E, 51, 51C, 61, 61C, 71, 81, and 81C are designed to provide port capacities from tens of ports to thousands of ports. These ports are normally local to Meridian 1. However, by implementing Carrier Remote IPE, some of these ports are located at one or more remote sites.

The system's physical capacity depends on the system type. Systems supporting Carrier Remote IPE service are NT and XT. They provide port capacities from tens of ports to thousands of ports.

The overall system capacity does not change by installing Carrier Remote IPE. The difference between a system with Carrier Remote IPE and without Carrier Remote IPE is the distribution of line cards, that is, the subscriber loops. Carrier Remote IPE allows you to distribute the peripheral equipment at long distances from the system and provide the same functions and features to remote subscribers as to local subscribers.

Note: System port capacity may be affected by the capacity of the Local Carrier Interface card, which supports only one IPE module instead of two IPE modules as supported by the standard superloop network card. Call blocking grade of service for the remote voice and data terminals depends on the number of active carriers in the link.

The Carrier Remote IPE capacity can be tailored according to port capacity requirements at the remote site. When planning a Carrier Remote IPE site, you must determine the number of IPE cards that are required to support the existing traffic needs and future requirements. Based on these requirements and the equipment location preference, there are two Carrier Remote IPE hardware options available:

- Carrier Remote IPE column
- Carrier Remote IPE cabinet

Carrier Remote IPE column

The Carrier Remote IPE column consists of the Meridian 1 pedestal, IPE module, and a top cap. One IPE module supports up to 16 line cards, or 256 ports if each line card has 16 ports. If more ports are required, additional IPE modules can be added to the column. A column contains a maximum of four modules. Each IPE module requires one Remote Carrier Interface card located in the IPE module and a corresponding Local Carrier Interface card located in the system network card slot.

Note: A superloop network card can support up to two IPE modules. However, in a system with the Carrier Remote IPE configuration, a Local Carrier Interface card supports only one Remote IPE module. This is due to the dedicated carrier link configuration between the Local Carrier Interface card and the Remote Carrier Interface card. Since T1 or E1 carrier links are dedicated to one Remote Carrier Interface card, they cannot be shared between two different IPE modules at the remote site.

Carrier Remote IPE cabinet

The Carrier Remote IPE cabinet consists of an NT1P70/NT1P60 main and an NTBK70 expansion cabinets. The main cabinet supports the Remote Carrier Interface card and up to ten IPE cards or 160 ports. If more ports are required, an expansion cabinet can be installed adjacent to the main cabinet.

These two cabinets are linked with an inter-cabinet cable that plugs into 50-pin connector P1 located at the bottom left-hand corner of each cabinet. This cable extends six peripheral bus DS-30X loops to the first six IPE card slots in the expansion cabinet. One Remote Carrier Interface card located in the main cabinet supports cards in both main and expansion cabinets as long as the expansion cabinet contains no more than six IPE cards installed in the first six IPE card slots. The remaining card slots from 17 through 20 must not be used.

Engineering the T1 carrier link

A T1 carrier link is constructed using twisted-pair wire over the private or public network.

When engineering a carrier link, you must determine the number of links required to support the traffic at the remote site. Local and Remote Carrier Interface cards support from one to three T1 carrier links. These three links can be used as primary links without a spare, or two links can be used as primary and the third link can be used as a spare link. The spare link is used when one of the primary links fails. In that case, the traffic from the failed link is automatically switched to the spare link.

The T1 carrier link used twisted-pair wire. The public network link construction is the responsibility of the local telephone company. The only cable routing that has to be done at the local and remote sites is from the telephone company's telco demarcation point or line terminating unit (LTU) to the system and to the Carrier Remote IPE column or Carrier Remote IPE cabinet.

If a private T1 network is used, the same conditions as with the public network apply, that is, the only cable routing that has to be done at both sites is from the CSU or telco demarcation point to the system and to the Carrier Remote IPE column or Carrier Remote IPE cabinet, assuming that the carrier link already exists and does not have to be constructed.

The local carrier interface and the remote carrier interface to the carrier link are designed for in-house environment carrier protection. To protect the carrier link in the external environment, which is susceptible to lightning, external line protection circuits similar to trunk protection circuits are required before the carrier link exits the building.

The carrier link line coding is B8ZS. The source of the clock for the carrier links is the Meridian 1 system. The preferred framing for the T1 link is ESF (D4 is also supported).

Engineering the E1 carrier link

An E1 carrier link can be constructed using coaxial cable or twisted-pair wire over the private or public network.

When engineering a carrier link, you must determine the number of links required to support the traffic at the remote site. Local and Remote Carrier Interface cards support from one to three E1 carrier links. These three links can be used as primary links without a spare, or two links can be used as

primary and the third link can be used as a spare link. The spare link is used when one of the primary links fails. In that case, the traffic from the failed link is automatically switched to the spare link.

The E1 carrier link, in some applications, may use coaxial cable to span the distance between the system and the Carrier Remote IPE. The public network link construction is the responsibility of the local telephone company. The only cable routing that has to be done at the local and remote sites is from the telephone company's demarcation point or line terminating unit (LTU) to the system and to the Carrier Remote IPE column or Carrier Remote IPE Cabinet. If the E1 link uses coaxial cables and BNC connectors, use the NT7R67EA Coaxial Interface Adapter Cable (one RJ -48 to BNC adapter cable for each carrier in the link) and the impedance must be set to 75 Ohm using SW1, SW2, SW5, and SW8 on the Local and Remote Carrier Interface cards (refer to [Figure 9](#) and [Figure 15](#)).

An E1 carrier link may use coaxial cable connection from the Meridian 1 system and the Carrier Remote IPE to the corresponding LTU or telco demarcation point, but from there on, the network can use twisted pairs, coaxial cable, microwave, etc. as long as it meets the transmission quality required for E1 carrier communication.

If a private E1 network is used, the same conditions as with the public network apply, that is, the only cable routing that has to be done at both sites is from the LTU or telco demarcation point to the system and to the Carrier Remote IPE column or Carrier Remote IPE cabinet, assuming that the carrier link already exists and does not have to be constructed.

The local carrier interface and the remote carrier interface to the carrier link are designed for in-house environment carrier protection. To protect the carrier link in the external environment, which is susceptible to lightning, external line protection circuits similar to trunk protection circuits are required before the carrier link exits the building.

The T1 carrier link line coding is B8ZS. The E1 carrier link line coding is HDB3. The source of the clock for the carrier links is the Meridian 1 system.

Traffic engineering

Network blocking in Meridian 1 can potentially occur at three stages: the network loop or superloop associated with the originating port (line or trunk), the loop or superloop where the call terminates, and the inter-group junctors bridging the connection between two network groups in a multi-group system.

Note: When carriers are configured with carrier 2 as spare, carrier 0 will always have the sparing priority over carrier 1. If carrier 1 is spared and carrier 0 becomes faulty, carrier 0 will be spared and carrier 1 will be released.

In order to meet the overall Grade Of Service (GOS) requirement of 0.01 network blocking requirement, each blocking component in the network should not be greater than one third of the total blocking. Therefore, the blocking for a call at the originating part of the connection should be 0.0033 or less. It is this blocking probability that yields 660 CCS capacity for a loop and 3500 CCS capacity for a superloop in the traffic engineering procedure.

The engineering of Carrier Remote IPE is equivalent to engineering a segment of the call connection; it should follow the procedure recommended in this document. The rest of the system engineering will not be impacted by this component.

Traffic capacity

Traffic capacities of carriers meeting GOS requirements are summarized in [Table 4](#).

Table 4
Carrier capacity calculations

Carrier Type	T1			E1		
	1	2	3	1	2	3
Number of Carriers	1	2	3	1	2	3
Number of Channels	21	42	63	27	54	81
Traffic in CCS	408	1016	1665	575	1384	2235

There are some general guidelines to be followed before you start to engineer a Carrier Remote IPE:

- Traffic engineering for a Carrier Remote IPE with or without Central Office between Local Carrier Interface card and Remote Carrier Interface card is the same. This implies that available channels for any specific configuration in the CO or CO network are at least equal to the channels on the carrier to provide the GOS required.
- One Local Carrier Interface card is connected to one Remote Carrier Interface card only. There is no concentration option on the Carrier Remote IPE.
- One carrier out of two, or one carrier out of three, equipped is allowed to be a spare which serves as a backup during active carrier failure but will not carry traffic under normal conditions.
- Capacity calculation of carriers (E1 or T1) should exclude the spare carrier. In other words, if a spare carrier is provided, the maximum number of channels available for traffic is 42 for T1 and 54 for E1.
- If the number of equipped ports (lines or trunks) is less than the number of channels (or time slots) in the carrier, there will be no blocking at the carrier or superloop. Traffic per port can be up to 36 CCS.
- Non-blocking on a carrier Carrier Remote IPE superloop is not sufficient to guarantee a non-blocking system. Other parts of the call connection need to be considered.
- Traffic requirements for lines or trunks are normally specified by a customer. When it is not specified, the default number of 6 CCS per line, 26 CCS per trunk, 30 CCS per ACD agent and 18 CCS per data port can be used.
- Current digital line card allows 16 voice ports and 16 data ports. Unused data ports can not be used for voice lines. In other words, an Integrated Voice and Data line card can support 16 voice lines or 16 integrated voice and data pairs. A port is the generic term for a line, trunk, or data terminal.

- A trunk card can provide eight trunk ports.
- An IPE module can accommodate 16 cards, of which any combination of cards are permitted.
- Digitone Receiver (DTR) cards should not be installed into the Carrier Remote IPE cabinet or the Carrier Remote IPE module due to the unnecessary use of carrier channels and remote IPE card slots.
- A Carrier Remote IPE cabinet version of the Carrier Remote IPE may consist of a 10-slot main cabinet and 6-slot expansion cabinet providing a maximum of 16 card IPE capacity. There may be cost advantages to equipping Carrier Remote IPE cabinets in a multi-shelf configuration, if a cabinet is equipped with no more than 10 cards.
- All line/trunk cards, card slot and carrier calculations are to be rounded up to the next higher integer number.
- Capacity calculations of lines and trunks allowed per carrier should be rounded down to the next lower number.
- When several IPE modules or Carrier Remote IPE cabinets are required in the configuration, it is preferable to fill up the first IPE module or cabinet card slots until either all slots are filled or the carrier traffic limit is reached before equipping the second one. This way, when adding traffic or cards to the partially filled enclosure, the first module or cabinet will not need re-engineering.
- When no growth is planned, even distribution of traffic among several IPE modules or Carrier Remote IPE cabinets is quite acceptable.
- Carrier Remote IPE cabinet installation guide: (1) 1–10 cards, use a Carrier Remote IPE cabinet. (2) 11–16 cards, use an IPE module. (3) 17–20 cards, use two Carrier Remote IPE cabinets. (4) 21–26 cards, use one IPE module and one Carrier Remote IPE cabinet. (5) 27–32 cards, use two IPE modules. Repeat the same rule for additional card slots required. Of course, the final configuration will also depend on traffic requirements.

Engineering Procedure

The following procedures determine the system terminal configuration for determining system traffic capacity.

Given the number of carriers, calculate ports allowed.

- 1 Determine traffic capacity at the carriers. Read off the CCS number from [Table 4](#) under the specified number of carriers as the maximum capacity allowed for that carrier size.
- 2 Determine the number of lines allowed. Divide the CCS number by 6 CCS for line or 26 CCS for trunk or any other numbers provided by the customer.
- 3 Determine the number of card slots required. The number of lines divided by 16, the number of trunks divided by 8 or the number of integrated voice and data lines divided by 32 to obtain the number of card slots required.
- 4 An IPE module has 16 card slots, a Carrier Remote IPE cabinet has 10 card slots.
- 5 If the number of card slots is less than or equal to 16 (or 10), the resulting configuration is within the traffic capacity of the carrier provided.
- 6 If the number of card slots allowed is greater than 16 (or 10), it means that the carrier can handle more traffic than an IPE module or Carrier Remote IPE cabinet can generate. When all 16 (or 10) card slots are filled, the carrier may still have spare capacity for extra traffic.

Given port CCS, determine the number of carriers required.

- 1 Multiply the number of lines by CCS per line, the number of trunk by CCS per trunk, etc. and sum them up to obtain the total traffic offered to the carrier.
- 2 Look up [Table 4](#) under the T1 or E1 column to find the CCS number greater than the calculated number, and find the corresponding carrier number to determine the number of carriers required.

- 3 If no number in [Table 4](#) is large enough to cover the calculated number, it means that the given configuration and traffic is too large for three carriers. Either the number of ports, or the CCS per port or both have to be reduced. The resulting number has to be less than the entry from [Table 4](#) in order for the carrier to handle the given configuration.
- 4 If traffic and number of lines have to be maintained, multiple lines of carriers and cabinets will be needed.
- 5 Be sure to use only columns with 1 or 2 carriers in [Table 4](#), if a spare carrier is to be used.
- 6 The port counts in the final configuration should be within the slot limitation of the Carrier Remote IPE enclosure (16 for IPE module, 10 for the Main Carrier Remote IPE cabinet and 6 for the Expansion Carrier Remote IPE cabinet).

Engineering Examples

Engineering examples are developed to illustrate the procedure described above. They cover only traffic capacity issues specifically associated with Carrier Remote IPE engineering.

Given the number of carriers to find allowed ports and required enclosures.

Example 1: Three T1 carriers are provided to serve a Carrier Remote IPE. All ports are lines with 6 CCS each.

Find the maximum number of lines three T1 carriers can support.

- 1 From [Table 4](#), the CCS that can be handled by three T1 carriers is 1665.
- 2 Divide CCS by 6: $1665/6=277$. Traffic generated by 277 lines at 6 CCS each can be supported by three T1 carriers.
- 3 Calculate card slots: $277/16=17$. This number is greater than the 16 slots available in an IPE module.
- 4 Calculate maximum allowed lines: $16 \times 16=256$, or $16 \times 10=160$. 256 lines (or 160 lines) with 6 CCS each are the maximum number of lines allowed for each Remote IPE module or Remote IPE cabinet for three T1 carriers.

Configuration for Mixed Sets, Trunks and Data Terminals.

Example 2: A remote data processing center is connected to the main office through private E1 carriers. For reliability purposes, spare carriers are required as backups.

Find the configuration to support 80 integrated voice and data lines at 6 CCS for voice and 14 CCS for data, and 20 trunks at 26 CCS each.

- 1 From [Table 4](#) under E1 heading, two carriers can serve 1384 CCS (with spare, two carriers are the maximum link size per each Carrier Remote IPE module or Carrier Remote IPE cabinet).
- 2 Calculate total offered traffic: $80 \times 6 + 80 \times 14 + 20 \times 26 = 1600 + 520 = 2120$ CCS. This number is larger than 1384 but less than 2768 ($=2 \times 1384$). The offered traffic is too much for two carriers but within the capacity of four carriers (two lines of two carrier links). Note that the integrated lines alone generate more traffic (1600 CCS) than two carriers can handle, they need to be split between two IPE modules or Carrier Remote IPE cabinets.
- 3 Calculate card slots: $(80+80)/32 + 20/8 = 5 + 3 = 8$. There are sufficient card slots in one cabinet to handle the required ports. Even though the configuration exceeds the traffic capacity of one carrier group in Step 2, it is still a good idea to check physical constraints to determine whether traffic is the only constraining parameter.
- 4 Configuration Summary:
 IPE1 (Carrier Remote IPE cabinet): 3 32-port IVD cards, 1 trunk card, 3 E1 carriers including one spare.
 IPE2 (Carrier Remote IPE cabinet): 2 32-port IVD cards, 2 trunk cards, 3 E1 carriers including one spare.

Given ports and traffic to find carriers and cabinets. Non-blocking Sets Only (two Carrier Remote IPE cabinets)

Example 3: A Carrier Remote IPE is located in an airport fire station two miles from the main terminal building where the Meridian 1 is installed. There are 80 lines in the Carrier Remote IPE where non-blocking network and a spare carrier on the carrier group are required. What is the most cost effective configuration to serve this site?

- 1 To provide non-blocking to 80 lines, 80 channels are required at the carrier.
- 2 From [Table 4](#), two T1 carriers can provide 42 channels, which are just enough to serve half of the requirement.
- 3 Calculate card slots: $80/16 = 5$. Only five card slots are needed for this application. However, if three cards are fully equipped with lines in one IPE module or Carrier Remote IPE cabinet, the 48 lines will exceed the channel capacity of two-carriers at 42 for non-blocking. Three partially equipped cards are needed. The total ports should be 42 or less at any IPE module or Carrier Remote IPE cabinet.
- 4 Configuration Summary:
IPE1 (Carrier Remote IPE cabinet): 42 non-blocking lines, 3 cards, 3 E1 carriers including one spare.
IPE2 (Carrier Remote IPE cabinet): 38 non-blocking lines, 3 cards, 3 E1 carriers including one spare.

To split lines 40-40 in this application is also acceptable. However, future growth should be kept to 42 lines maximum at each cabinet.

Blocking Network (one IPE module and one Carrier Remote IPE cabinet)

Example 4: A university providing E1 carrier telephone services to 400 boarding students is located one mile away from the main administrative building where the Meridian 1 is located.

Find the configuration required to serve this remote site, if the estimated busy hour per line is 6 CCS.

- 1 Calculate traffic: $400 \times 6 = 2400$ CCS. This number is greater than the capacity of 3 E1 carriers (2235 CCS). From a traffic standpoint, two IPE modules are needed.
- 2 Calculate card slots: $400/16 = 25$. This also indicates that two IPE modules are needed. However, one IPE Module with 16 card slots and a Carrier Remote IPE cabinet with 10 card slots are sufficient to meet the need.
- 3 Calculate traffic, card slots and carriers for the first IPE module:
 $2235/6 = 372$ lines.
 $372/16 = 24$ cards. This number is > 16 . Only 16 cards are allowed for the first IPE module.
 $16 \times 16 = 256$. 256 lines at 6 CCS each is equipped for the first IPE module
 $256 \times 6 = 1536$ CCS. From Table 3, this number still requires three E1 carriers.
- 4 Calculate traffic, card slots and carriers for the second IPE module or Carrier Remote IPE cabinet:
 Remaining lines: $400 - 256 = 144$
 Card slots: $144/16 = 9$
 Traffic: $144 \times 6 = 864$ CCS
 Carriers required: From [Table 4](#), 2 E1 carriers can handle 1384 CCS which should be enough to serve the 864 CCS from 144 lines (but one carrier at 575 CCS is not quite enough).
- 5 Configuration Summary:
 IPE1 (IPE module): 6 CCS/line, 256 lines, 16 cards, three E1 carriers.
 IPE2 (Carrier Remote IPE cabinet): 6 CCS/line, 144 lines, 9 cards, two E1 carriers.

System planning and ordering

Meridian 1 and SL-1 systems provide the user with a variety of system size and feature options. To select a system option that will best suit your current and future communication needs, you must carefully plan your system. Contact your Northern Telecom representative or your Northern Telecom distributor to help you plan the system.

If you are installing a new Meridian 1 with Carrier Remote IPE, refer to *Meridian 1 installation planning* (553-3001-120) and *Meridian 1 system engineering* (553-3001-151) for overall system information. To obtain specific planning and ordering information for T1 and E1 carrier links interfacing with network and peripheral cards, see the following sections.

System selection

Determine the type of Carrier Remote IPE enclosure. This selection may be dictated by the installation preference, blocking considerations, and the number of IPE cards required at the remote site.

If you plan a floor-standing system, you can use the Carrier Remote IPE column or the pedestal mounted Carrier Remote IPE cabinet. If you plan a wall-mounted system, you need the Carrier Remote IPE cabinet.

In some applications where nonblocking or low blocking traffic considerations are important, you have to limit the number of peripheral cards supported by each Remote Carrier Interface card. For a nonblocking condition, the 63 voice/data timeslots for three T1 carriers support four 16-port line cards; the 81 voice/data timeslots for three E1 carriers support five 16-port line cards. Each additional line card in the IPE module or the Carrier Remote IPE cabinet increases call blocking under high traffic conditions. Refer to *Meridian 1 system engineering* (553-3001-151) for traffic calculations.

With a spare carrier for a nonblocking traffic condition, the number of stations is reduced by 21 for the T1 carrier and by 27 for the E1 carrier.

The system type may also be dictated by the number of ports required at the remote site. The modular column configuration supports 16 line cards and provides a maximum of 256 ports. This column can be expanded by adding a second IPE module to support an additional 256 ports. Each IPE module, however, requires a Remote Carrier Interface card at the remote site and a corresponding Local Carrier Interface card at the local Meridian 1 or SL-1 site.

In addition to line cards, the Carrier Remote IPE supports all the cards that do not require external connection to the system common or network equipment.

The Carrier Remote IPE cabinet system configuration supports ten line cards. You may want to select the Carrier Remote IPE cabinet system type if your system size requirement is less than ten IPE cards. To expand this type of system beyond ten IPE cards, you must add a Carrier Remote IPE expansion cabinet adjacent to the main and install up to six IPE cards into the first six IPE card slots of the expansion cabinet.

Carrier Remote IPE site planning

When you select a site for your Carrier Remote IPE, you must consider the number of ports currently required at the site and the possibility of expansion to meet future needs. You also must consider the environmental, power, and cable routing requirements.

Environmental requirements

Carrier Remote IPE equipment conforms to the same environmental requirements as the system equipment. Temperature, humidity, and altitude for the system operation should not exceed the specifications shown in [Table 5](#).

[Table 5](#) shows the operating and storage environmental specifications. Ideally the system should operate in a stable environment at 22° C (72° F). However, the system is designed to operate in the temperature and humidity ranges specified in [Table 5](#).

Table 5
Environmental requirements

Condition	Environmental specifications
Operating	
Temperature	0° to 50° C (32° to 122° F)
Relative humidity	5% to 95% noncondensing
Altitude	3,048 meters (10,000 feet) max
Storage	
Temperature	–50° to 70° C (–58° to 158° F)
Relative humidity	5% to 95% noncondensing

Power requirements

At the remote site, cards in the IPE module are powered by the power supply installed on the left-hand side of the IPE module. The power consumption of the Remote Carrier Interface card is not significantly different from power consumption of the standard Peripheral Controller card. This allows the standard IPE module's power supply to be used in the Carrier Remote IPE column.

Similarly, the Carrier Remote IPE main cabinet power supply, which is installed in the left-hand side of the cabinet shelf, provides power to the Remote Carrier Interface card and up to ten IPE cards. The expansion cabinet requires its own separate power supply to provide power to an additional six IPE cards.

The Carrier Remote IPE cabinet can be powered with an AC power system using the NTAK04 AC/DC power supply.

It can also be powered with a DC power system using the NTA05 DC power supply from a –52 V battery source through the NTA28AA Junction box and the NTA410 power cable. For additional information refer to *Option 11 Installation guide 553-3011-210*.

Table 6 shows the power supply DC output voltages and currents they supply to the Local Carrier Interface (LCI) and Remote Carrier Interface (RCI) cards. It also shows the corresponding total power consumption for each card.

Table 6
LCI and RCI power requirements

Voltage source in VDC	LCI card	RCI card
+5V	4.0 A	3.7 A
+15V	70 mA	50 mA
–15V	70 mA	50 mA
+12V	70 mA	50 mA
–12V	70 mA	50 mA
Total Power	23.8 W	21.2 W

Carrier cable requirements

A link can include up to three carriers. In a Carrier Remote IPE column, the carrier link terminates into the I/O panel connectors at the rear of the IPE module. In a Carrier Remote IPE cabinet, the carrier link terminates into the I/O panel connectors mounted on a bracket at the lower left-hand side at the front of the Carrier Remote IPE cabinet.

The Carrier Remote IPE UEM column and the Carrier Remoter IPE cabinet support T1 or E1 carrier links. These carrier links are terminated as follows:

- T1/E1 carrier links use twisted-pair wires (120-ohm impedance) and terminate into 8-pin modular jacks.
- E1 carrier links may in some cases use coaxial cables (75 ohm impedance) and terminate into BNC connectors, requiring a RJ48 to BNC adapters (supplied with the equipment) to connect the link to the Carrier Panel assembly at the UEM I/O panel.

Carrier equipment planning form

[Table 7](#) displays a planning form to use when ordering your carrier equipment. Enter the part number and the quantity for each item required at the local and the remote site.

Table 7
Planning form

Select one carrier type: T1 or E1 (circle the selected carrier type and enter only items required for that carrier type). Refer to Tables 1–3 .			
Item	Part Number	Quantity at Meridian 1	Quantity at Remote IPE